Flax fibre offers cotton cool comfort

By Rosalie Marion Bliss, Agricultural Research Service Information Staff

Nothing gets between folks and their favourite pair of jeans like hot, steamy summer weather. When the mercury rises, classic blue jeans — which are made of thick cotton fabric — can feel heavy under the weight of absorbed moisture. But ARS researchers at Clemson, South Carolina, have created a cotton-flax denim blend that will make jeans more comfortable to wear even in summer.

Flax is two to three times stronger than cotton, making it one of the strongest natural fibres known.

The flax plant species *Linum usitatissimum* is made into linen fabrics, linseed oil, and even linoleum flooring. Its acreage in the United States dropped in the 1920s with the arrival of synthetic fibres. But new, high-yielding and disease-resistant flax varieties could help reestablish a North American flax fibre industry.

Mopping up moisture

Mechanical engineer Jonn A. Foulk, with the ARS Cotton Quality Research Station, Clemson, South Carolina, has been spinning cotton with flax at a ratio that imparts better moisture management to denim fabric. The blend's fibres naturally absorb and transfer moisture away from the body.

The work is being done at the station's onsite high-tech pilot spinning laboratory.

Adding flax to clothing fabrics helps keep skin cool partly because the flax improves moisture wicking, which means channeling moisture away from the skin's surface. Another important feature of moisture management is air permeability, which allows fabrics to dry quickly.

Samples of raw flax (darker fluff) and raw cotton (lighter fluff) and yarns, woven denim, and knitted fabrics made with various blends of cotton and flax.
Photo by Stephen Ausmus.

If a fabric dries fast because it has high air permeability but it also has low moisture-wicking capacity, the moisture won't absorb sufficiently to be pulled away from the skin.

"Because cotton denim doesn't dry very fast after sponging water up, adding flax provides enough air permeability to speed up drying, providing the best of both worlds," says textile technologist David D. McAlister, who heads the Clemson station.

A good example of fabrics with low wicking are those made with traditional synthetic fibres, such as polyesters. They tend to hold moisture close to the skin, rather than wicking it away from the body.

"This natural flax fibre blend can enhance cotton's utilisation and can compete with specialty moisture-management synthetic fibres on the market," says David. "We're finding that adding a relatively small amount of these particular flax fibres provides important performance features to finished textiles."

Cool, but also strong

While flax-blended denim for jeans holds promise as a new niche market for the apparel industry, there is also good potential for blending flax with polymers to make molded materials. The resulting composites can be used in auto interiors for speaker boards and door panels and in molded machine covers.

At the Clemson laboratory's pilot spinning plant, flax fibres are cut to 2.5-inch lengths or less — called short-staple fibres — to make them compatible for blending with cotton for the denims and with polymers for the composites.

Embedding flax fibres into composite

materials and nonwoven sheets provides strength and reinforcement to the goods. Nonwoven sheets are made with short-staple fibres that are randomly aligned and entangled to create goods such as nappies and dish scrubbers. Woven sheets, on the other hand, are woven or knitted using spun yarns made from aligned fibres.

The facts about flax

In the past, spinning short-staple flax fibres with other fibres has been cumbersome for industry. "A certain percentage of trash and coarse fibres due to a lack of quality standards made high-speed spinning inefficient with short-staple flax," says Jonn.

To overcome the problem, the researchers have been collaborating with microbiologist Danny E. Akin, who is in the ARS Quality Assessment Research Unit in Athens, Georgia, to develop quality standards for grading flax fibres. They worked with ASTM International, in West Conshohocken, Pennsylvania, to create the first flax standards. "We helped develop terminology and fibre property measures that define how certain aspects of the fibre affect spinning and other products, such as composites and nonwovens," says Jonn.

The researchers are now collaborating with Akin to test an indoor enzymatic-retting procedure he developed. Retting is the process of separating the fibres from the stalks. Traditional dew retting is a slow process that takes place in the field. But by getting the flax out of the field for enzyme retting, the land is freed up for planting a second crop. The Clemson researchers are now testing the new process inside the pilot laboratory.

Friendly flax features

The new denims produced at the pilot spinning laboratory were blended using selected varieties of flax to produce fabrics that are low-cost and environmentally friendly. For example, byproducts from processing natural flax fibres are fully recyclable, whereas the byproducts generated from processing many synthetic fibres are not as readily recyclable.

Flax has been found to be a good candidate for growing in rotation with cotton in the US Southeast, particularly along coastal areas. The relatively warmer climate allows cool-season flax crops to be grown in winter to produce seed, oil, and fibre that can be used as healthy food ingredients, flax-containing yarns or textiles, composites, nonwovens, paper, and other industrial goods.

A producer, for example, might grow a cotton crop in early April for harvest from September through early November. In late November, the same producer might then plant a flax crop to grow through March.

The flax crop could then be harvested in time to plant another cotton crop in April. The cotton-flax crop rotation provides producers an alternative crop for traditionally dormant fields.

The ARS scientists are now entering a research agreement with Clemson University researchers to experiment further with natural fibres for new materials that could be used for different composite applications. They're working to pinpoint specific flax varieties and processing methods that perform well in the United States.

This research is part of Quality and Utilization of Agricultural Products, an ARS National Program (#306) described on the World Wide Web at www.nps.ars.usda.gov.

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"Flax Fibre Offers Cotton Cool Comfort" was published in the November 2005 issue of Agricultural Research magazine.